Navy's Award-Winning Stratospheric Ozone Protection Program

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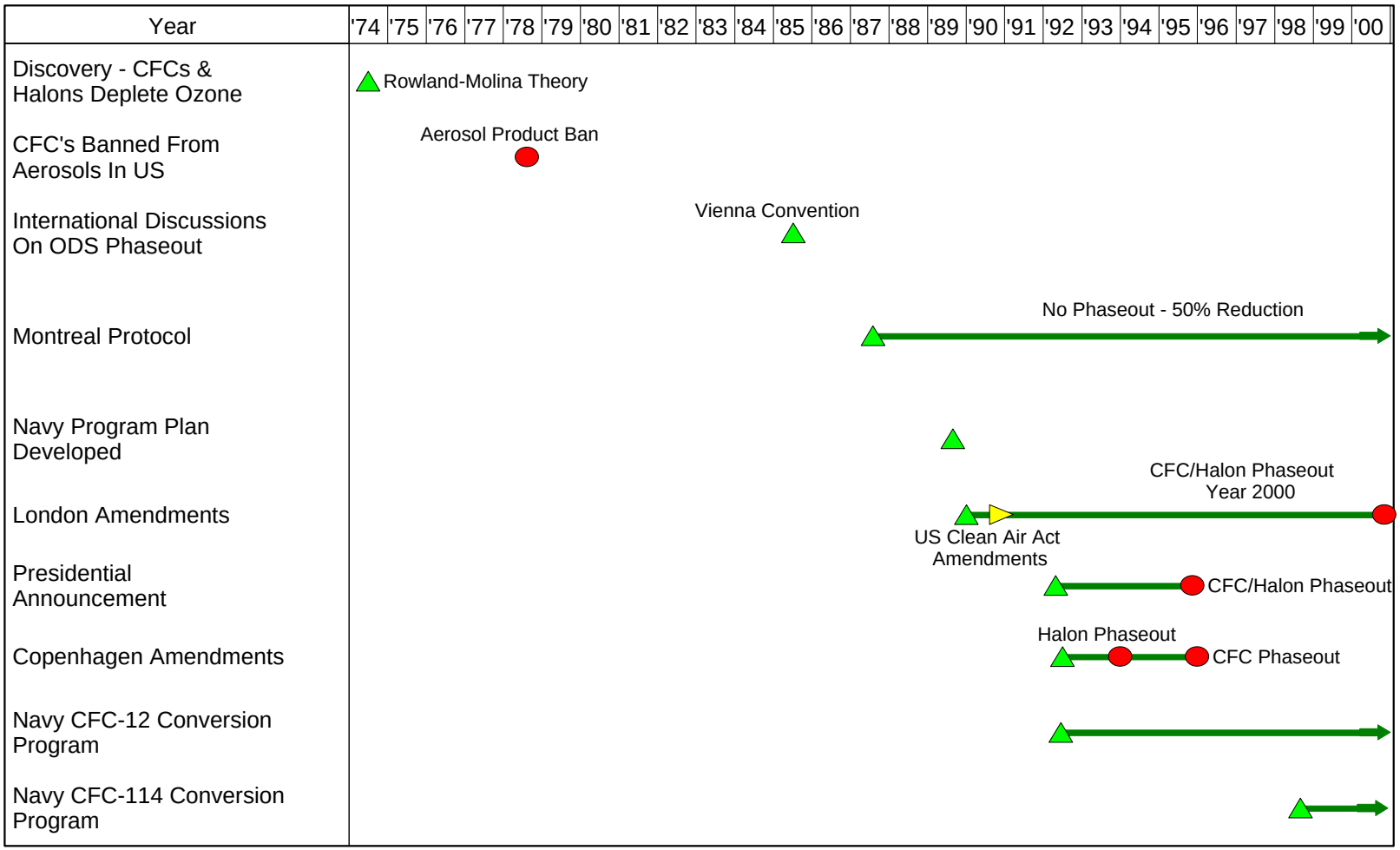
Agenda

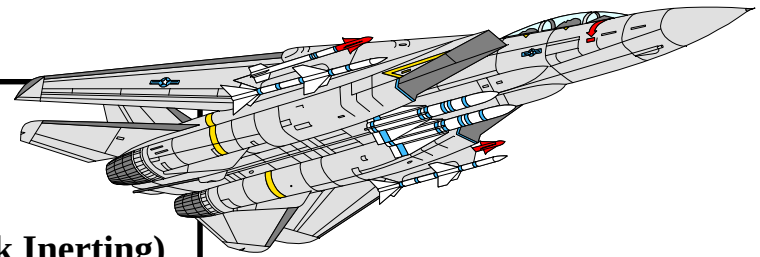
- ODS Production Phaseout History
- Navy ODS Uses
- Program Strategy
- Conservation
- CFC-12 Conversion Program
- CFC-114 Conversion Program
- Future Fleet AC&R
- Shipboard Halon 1301 Replacement Program
- Solvent Replacement Program
- Navy ODS Reserve
- Summary

ODS Production Phaseout



Typical Navy ODS Uses

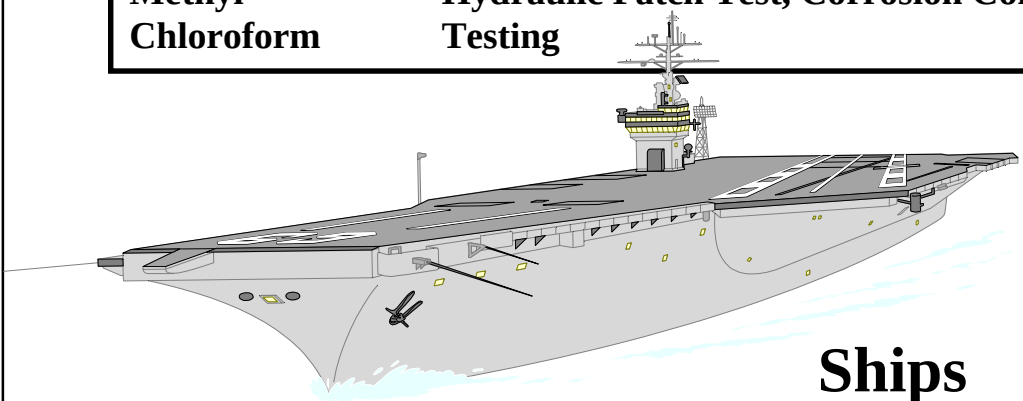
Aircraft



CFC-12, -114	Aircraft Cooling
R-500	(Avionics Cooling, Cabin Climate Control)
Halon 1211	Aircraft Crash, Fire, Rescue; Flightline
Halon 1301	Fire Protection (Engine Nacelles, Fuel Tank Inerting)
CFC-113	Electronics/Avionics, Oxygen Systems, Bearings,
Methyl Chloroform	Hydraulic Patch Test, Corrosion Control, Leak Testing

Shore Facilities

CFC-11, -12	Facilities AC&R
CFC-113	Electronics
Methyl Chloroform	Solvent Cleaning
Halon 1301	C^3 Fire Protection
Halon 1211	Portable Fire Extinguishers



Ships

CFC-11, -12, -114	AC&R (Electronics and Weapon Systems Cooling)
Halon 1301	Shipboard Fire Protection (Main Machinery Spaces)
CFC-113	Electronics , O_2 /N_2 Cleaning
Methyl Chloroform	

Program Strategy

- Conserve, Recover, Recycle
- Adopt Suitable Substitutes for Existing Equipment
- Develop New Non-ODS Equipment
- Strategic Reserves / “Vintaging”

Conserve, Recover, Recycle

- NAVSEA Sponsored Development & Procurement Of Recovery/Recycling Equipment
- Elimination Of Halon 1301 Discharge Testing - 60% of Usage
- Fleet Refrigerant Usage Reduction Efforts
  - AC&R Technician Certification
  - AC&R Message Advisories & ODS Advisories
  - Updated MRCs
  - UV Leak Detection Kits To Augment Current Electronic Leak Detectors
  - Maximum Leakage Rate Goals (OPNAVINST 5090.1B Chapter 19)
    - 15% For AC
    - 35% For Reefer

CFC Elimination Program -Refrigerants

Backfit

- 291 CFC-12 AC Plants
- 612 CFC-12 Refrigeration Plants
- 492 CFC-114 AC Plants

Forward Fit

- DDG 51 IIa
- LPD 17
- CVN 76*
- Virginia-Class SSN**

* SCN Funded by PMS 312
**PMS 450 funded

Alternative Cooling Technology

- Thermoelectric
- Thermoacoustic
- SBIRs

Submarine Life Support Compatibility

Strategic Reserve

CFC Elimination Laboratory

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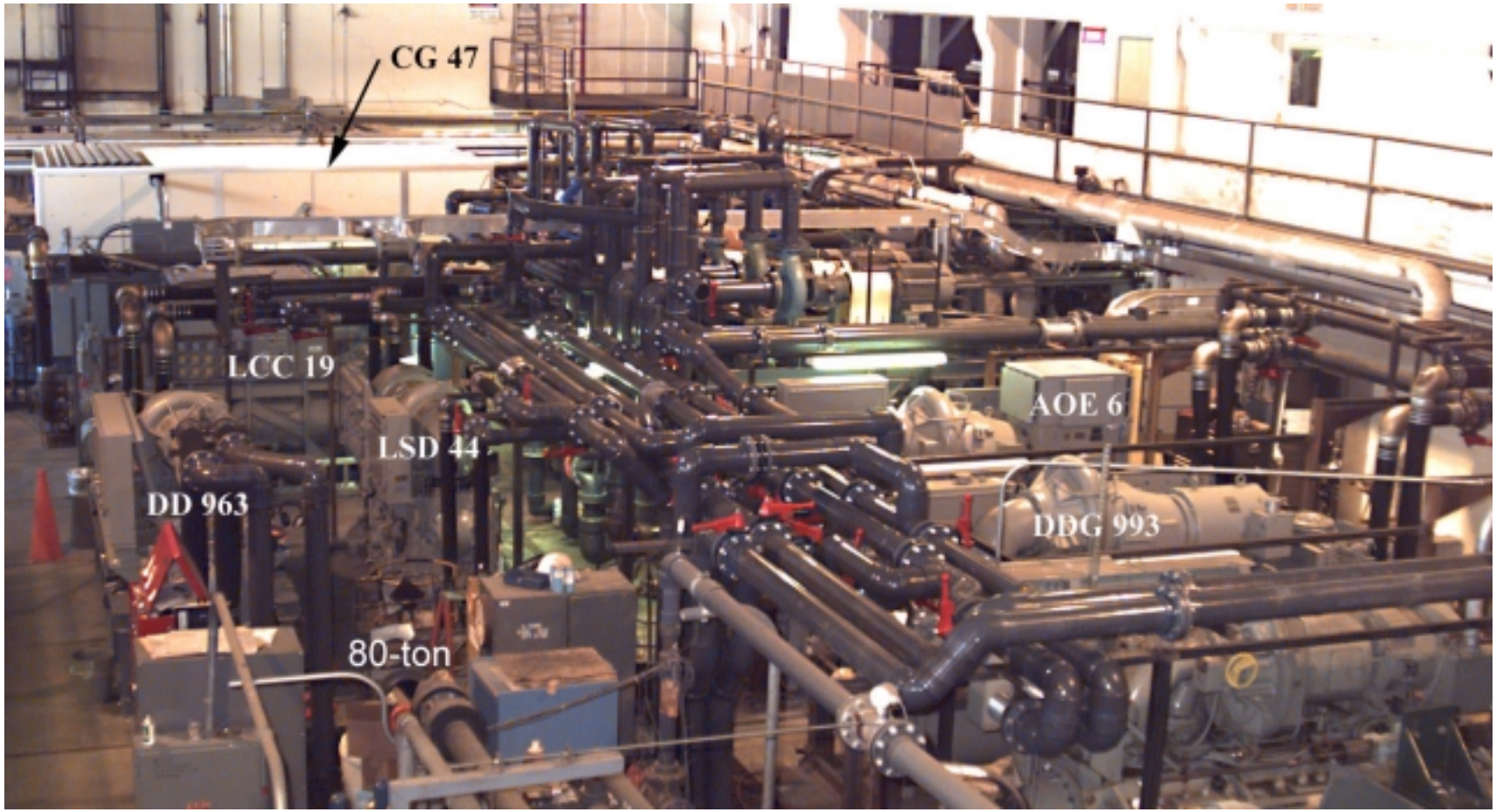
CFC Elimination Laboratory



CFC-12 Conversion Program

- 900+ Shipboard CFC-12 AC&R Plants Installed in the Fleet to be Converted
- Investigated Alternatives
  - Downselected to HFC-134a and Polyol Ester (POE) Lubricant
- Converted Two Test Ships
  - USS DEWERT (FFG 45)
  - USS MOUNT HOOD (AE 29)
- Conversion Program Underway (Scheduled Completion 2005)
  - 611 AC&R Plants Converted to Date by AIT
  - 158 CFC-12-Free Ships

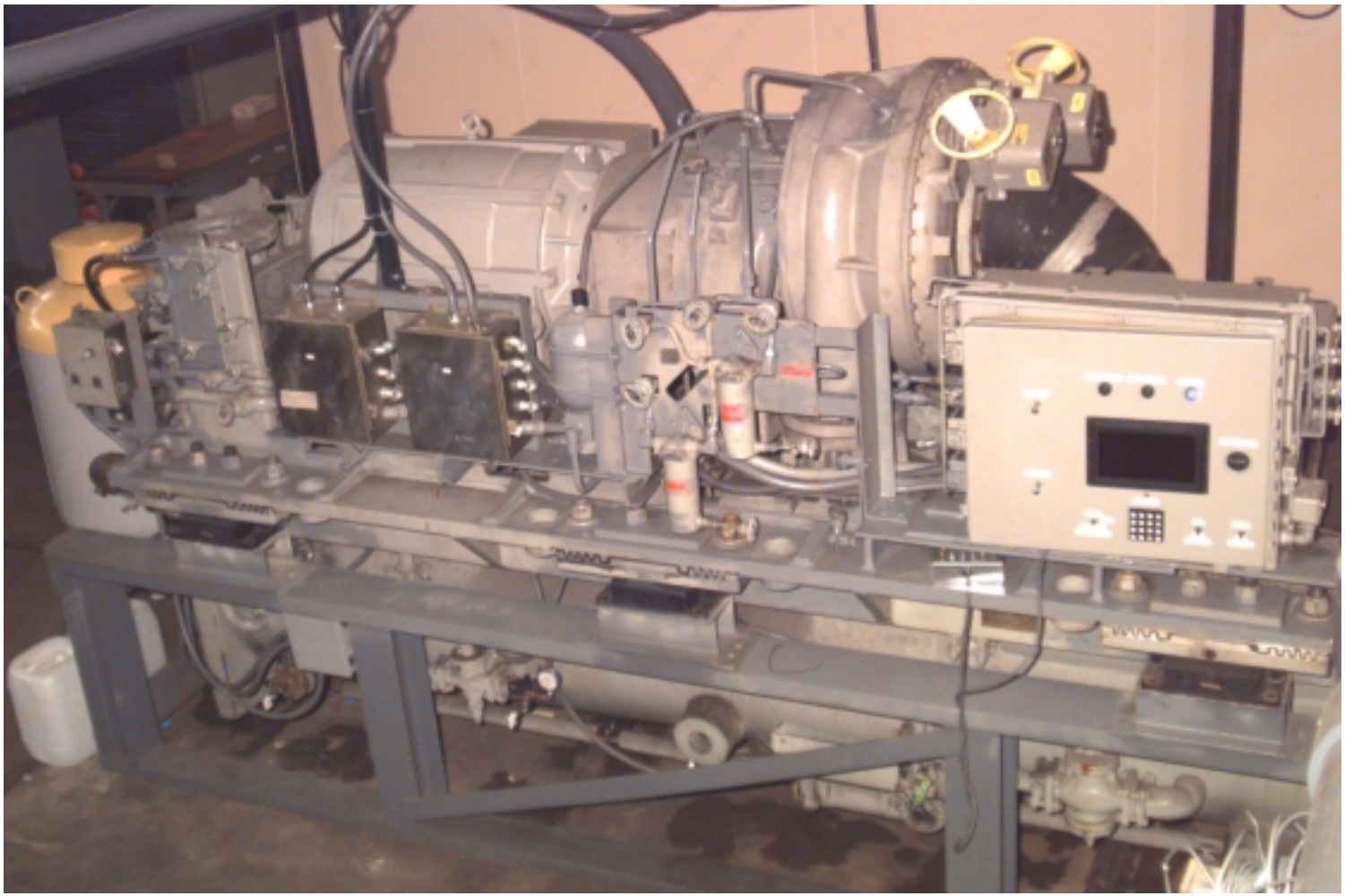
CFC-114 Conversion Program

- CFC-114 Centrifugal Compressor AC Plants
  - 125 to 363-ton Cooling Capacity
  - Used On All Submarines & Most Surface Combatants Except FFG 7
  - Approximately 492 Surface Ship Plants Will Require Conversion (107 Ships + 2 Training Schools)
  - "Vintage" Submarine AC Plants
- HFC-236fa is the Selected Substitute For CFC-114
  - First Conversions - USS NORMANDY (CG 60)
  - Fleet Conversion Program Underway
- Many Conversion Advantages
  - Quieter, More Reliable, Enhanced Troubleshooting / Diagnostics, Expanded Operational Envelope (95 F +), Improved Efficiency, etc.

HFC-236fa Conversion Kit

- Replace Compressor
  - Smaller Impeller
  - Variable Geometry Diffuser (VGD)
  - Reuse Existing Motor
- Replace Instrument and Control Panels
  - Add Two Electrical Junction Boxes
  - Add New Universal Microprocessor Control Panel
- Replace Venturi Flow Meter With New Target Flow Meter
- Electro-Hydraulic Condenser Water Control Valve
- Thermister Wells For Condenser Water & Chilled Water
- Hydrostatic Test Of Shell
- Relief Valves & Rupture Disk
- Oil Accumulator
- Purge & Pump-Out (PPO) Unit Modifications
- HFC-236fa Refrigerant & POE Lubricant

200-Ton CG 47 AC Plant Converted to HFC-236fa



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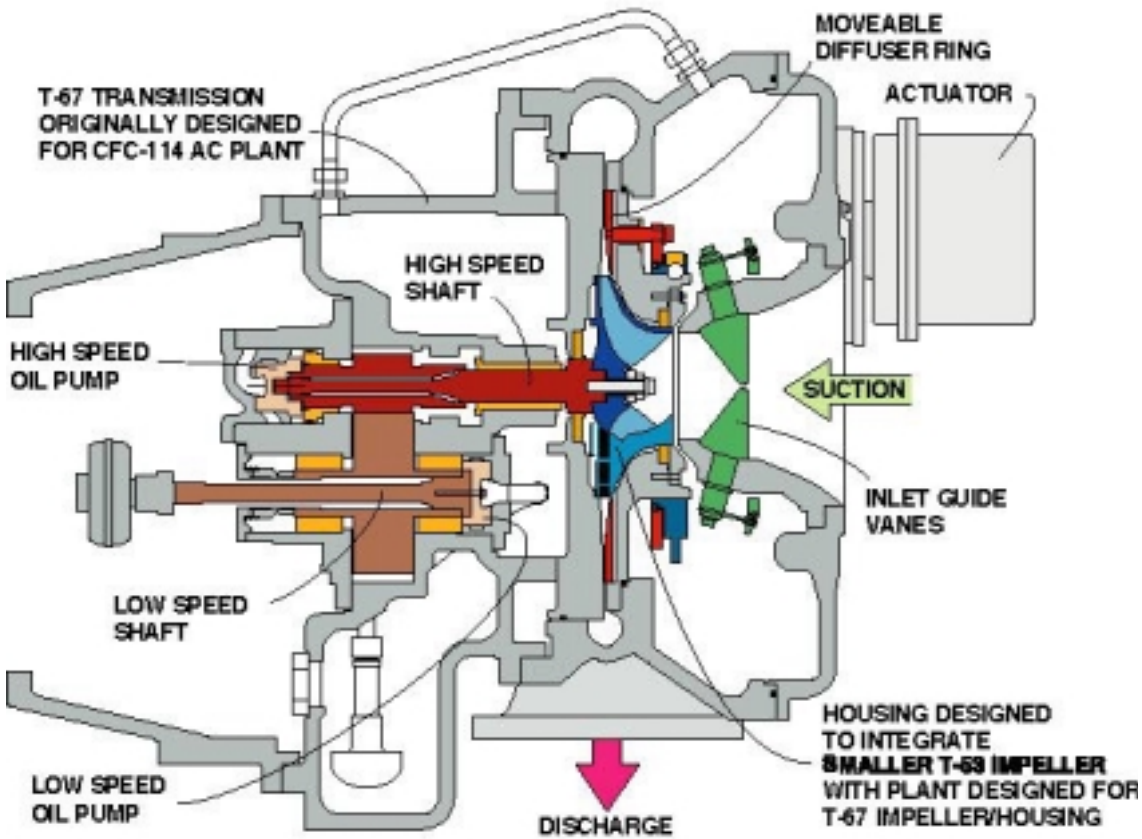
HFC-236fa Compressor With VGD

- Modified CFC-114 Compressor Design
- Replace Gas Section (Impeller) With Next Smaller CFC-114 Design (Except 363-Ton & 125-Ton)
- Keep Existing Motor/Drive Train
- Variable Geometry Diffuser (VGD)
  - Hot Gas Bypass Not Required For Partial Load Conditions
  - Increased Efficiency
  - Reduced Acoustic Signature

HFC-236fa Compressor With Variable Geometry Diffuser



Universal Microprocessor Control (USS NORMANDY)

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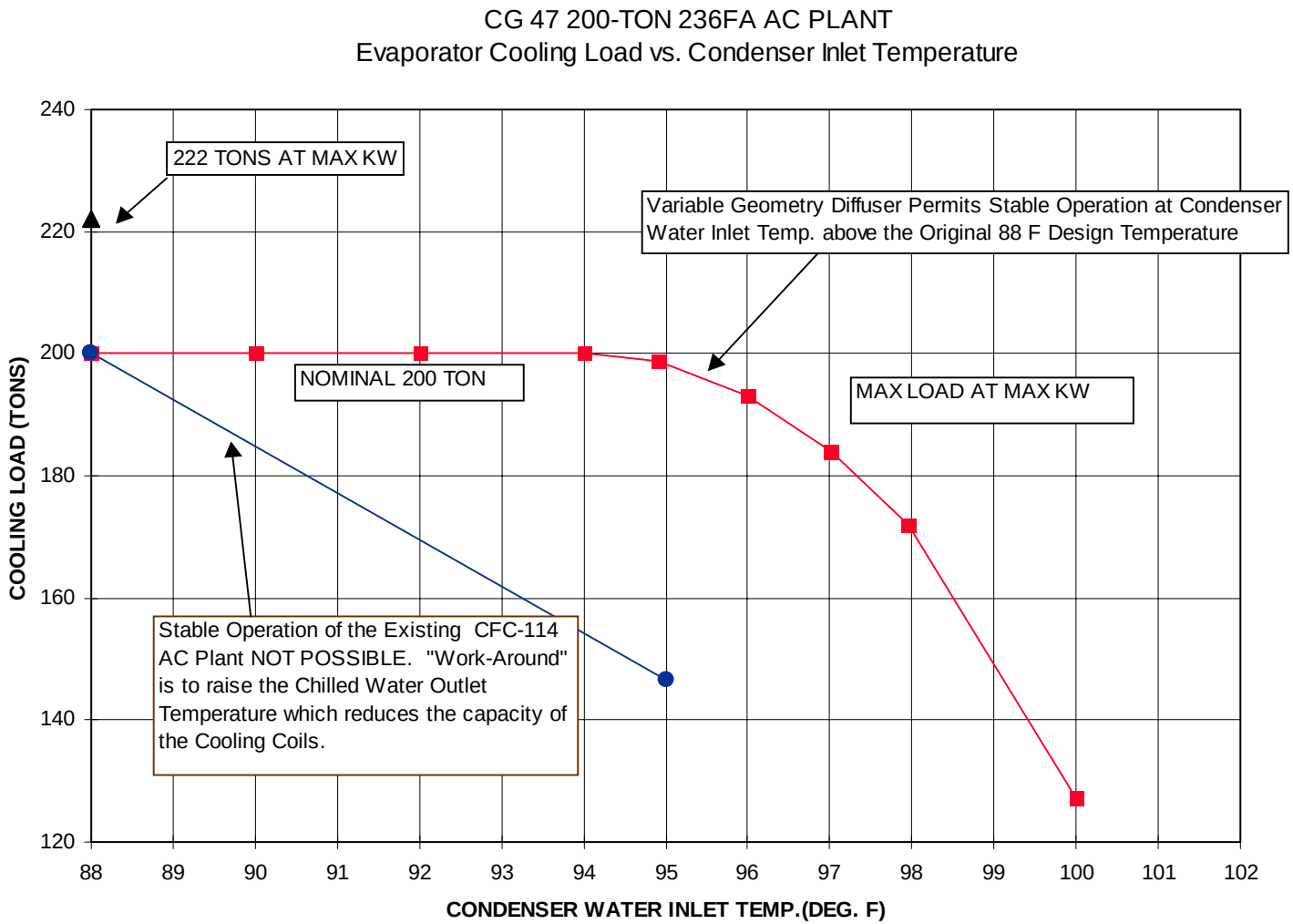
USS NORMANDY HFC-236fa Conversions

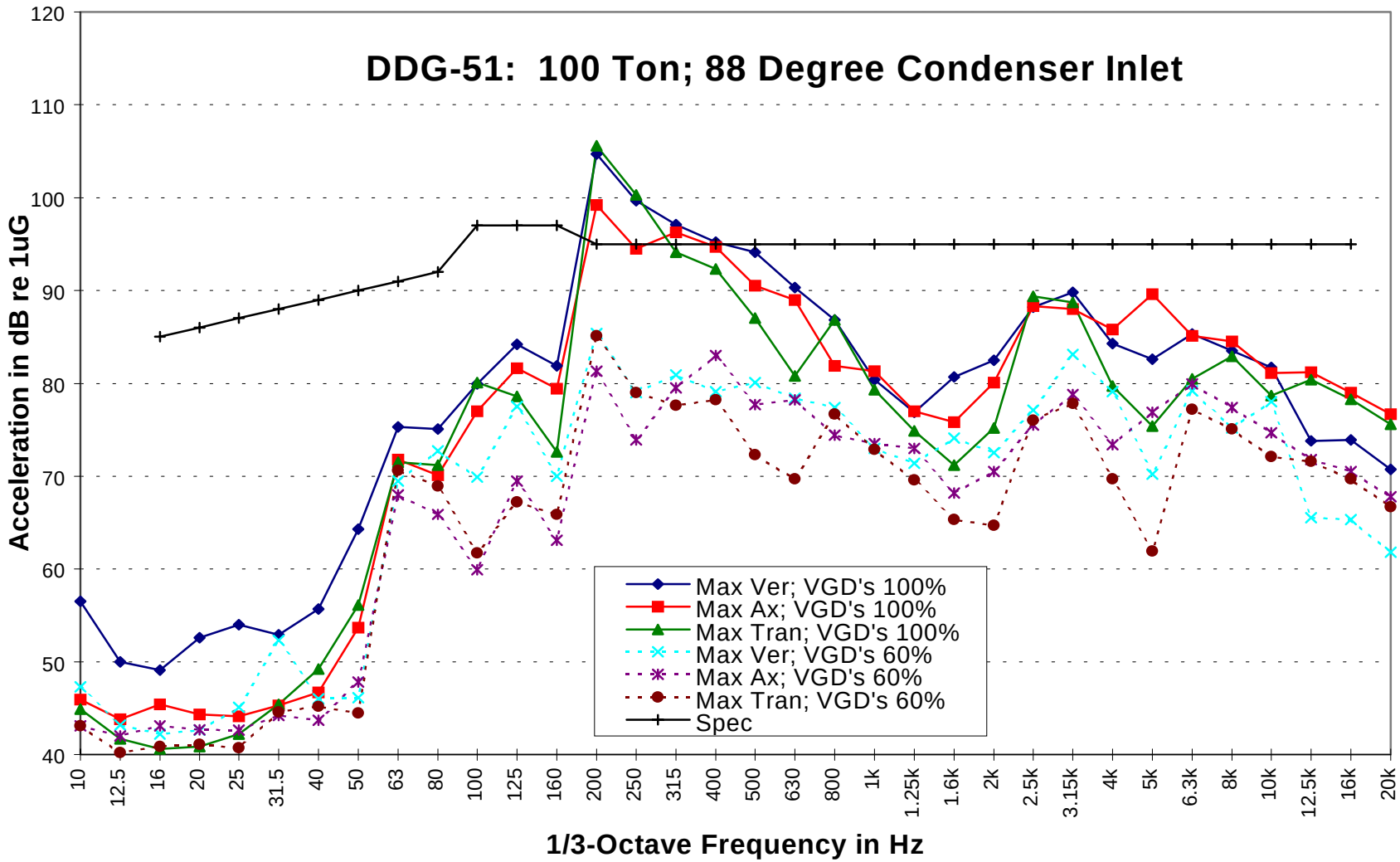
Advantages of Conversion

- Improved Operational Performance
  - Operations In Persian Gulf Above 88° F Seawater Temperature
- Enhanced Troubleshooting/Diagnostics
  - Universal Microprocessor Control
- Increased Reliability
  - 43% Increase In MTBF
- Reduction In Acoustic Signature
- Improved Efficiency - Reduced Energy (Fuel) Consumption
  - Reduced Operating Cost
  - Increased Range, Less Frequent UNREPs
  - Reduced Greenhouse Gas Emissions
- Capability To Add Future Reduced Manning Enhancements

Operation At Higher Temps

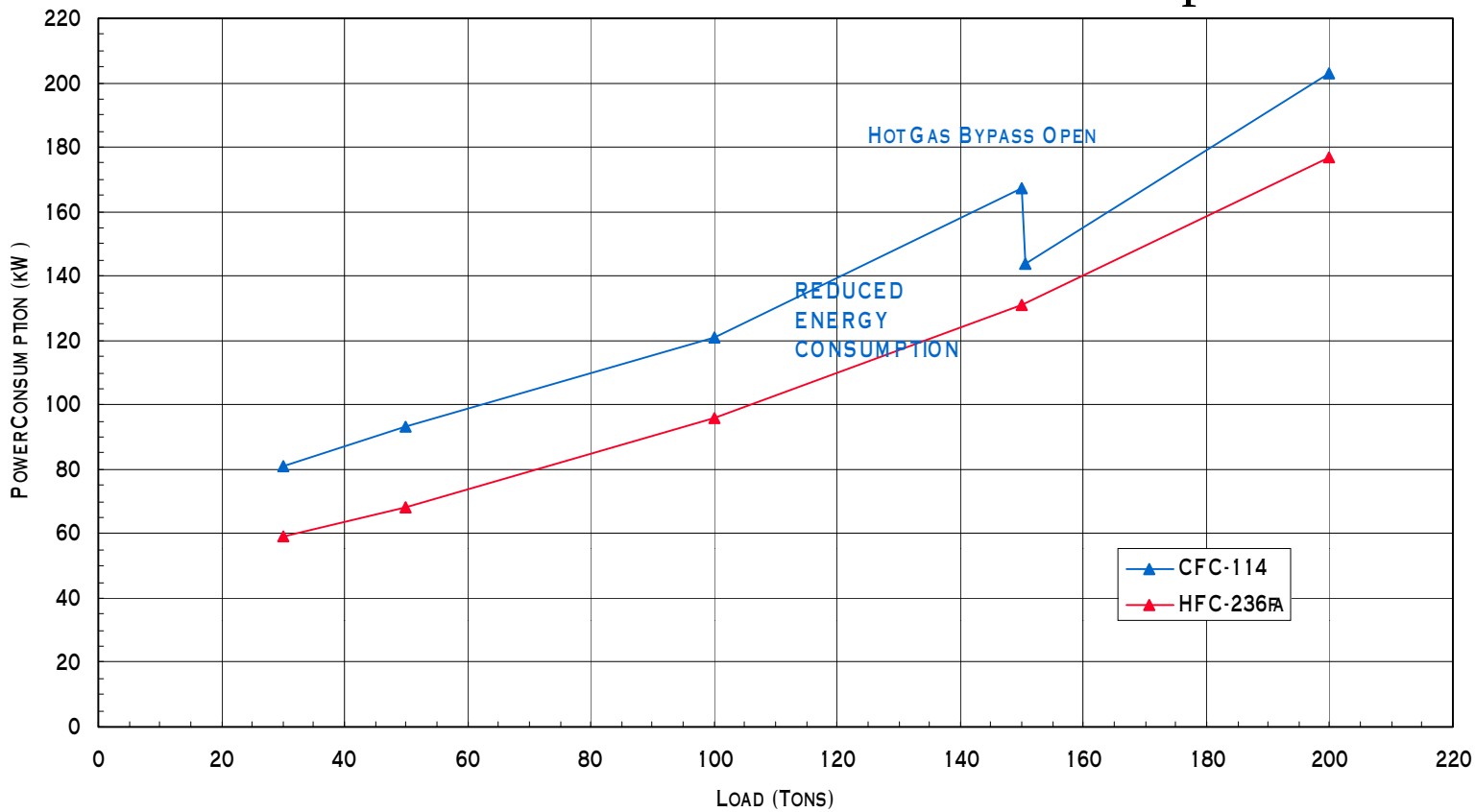


Acoustic Signature Reduction



Higher Efficiency

DDG 51 200 Ton AC Plant Power Consumption vs Load
at 88 °F Condenser Water Inlet Temp



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Future Fleet HFC-134a AC&R Plants

- Development Of New Design Plants Optimized For HFC-134a
  - Lab Investigations Of Commercial-Grade HFC-134a Centrifugal Compressor AC Plants
  - Rotary Compressor Refrigeration Development Facility Established New Construction AC&R Plant Designs
- Twin Screw Compressor AC To Replace Reciprocating Compressor Designs
- 200-Ton To 800-Ton Centrifugal-Compressor AC
  - DDG 51, LPD 17, VIRGINIA-Class SSN, CVN 76
- 1.5-Ton Rotary Vane Compressor Refrigeration Plant
- Cooperative Efforts
  - UK MOD Procuring Modified Version Of 125-Ton Twin Screw AC For TRAFALGAR-Class SSN

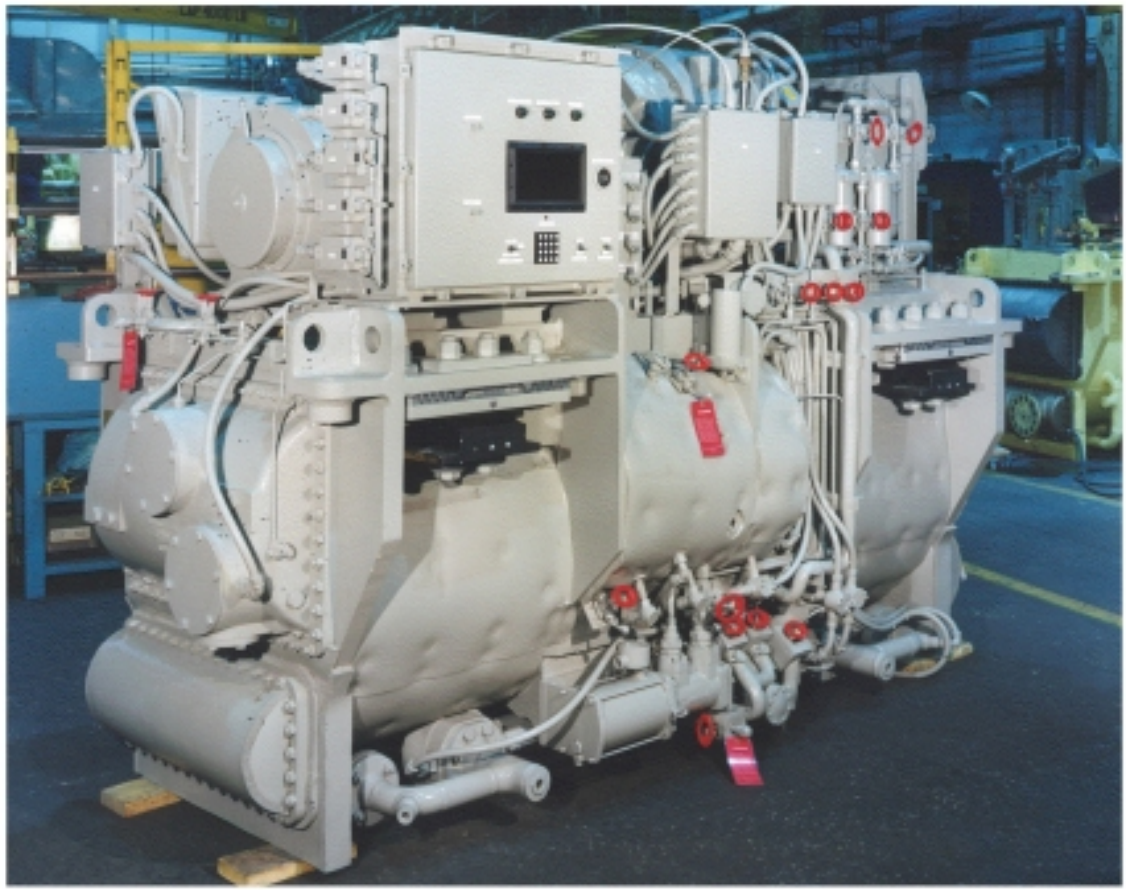
HFC-134a AC Plant Advanced Design Features

- HFC-134a, a Non-Ozone Depleting Refrigerant With Wide Industry Acceptance
  - Same Refrigerant Used In Automobile AC & Home Refrigerators
- Superior Efficiency
  - 20%-35% More Efficient Than Existing CFC-114 Designs
  - Variable Geometry Diffuser (VGD) - Provides Increased Efficiency and Acoustical Performance at All Operating Conditions
  - Variable Hot Gas Bypass - Increases Range and Minimize Impact on Efficiency by Providing Hot Gas Only When Absolutely Necessary
  - Enhanced Heat Transfer Surfaces

HFC-134a AC Plant Advanced Design Features

- Universal Microprocessor Panel
  - Identical to System Used by HFC-236fa Conversion Program
  - Enhanced Troubleshooting & Diagnostics
  - Provides Precise, Efficient Operation Through Advanced Control Algorithms
  - Interfaces With MCS to Provide Remote Start/Monitoring Capability
- Titanium Condenser - Light Weight and Erosion Resistant, Good for the Life of the Ship
- Rolled Tubes With Seal Welds Eliminates Refrigerant Leakage

200-ton Centrifugal Compressor AC Plant



Shipboard Halon 1301 Replacement Program

- Halon 1301 Used As Fire Extinguishing Agent For Flooding Applications In Machinery & Flammable Liquids Areas
- Critical For Ship Survivability
- Initial Testing Completed & Alternatives Selected
- Existing Ships Will Continue To Use Halon 1301 Until Decommissioning
  - Halon 1301 Stockpile Required Until Approximately 2050 (Last Ship Using Halon Is CVN 75)

New Construction Ships

- LPD 17 SAN ANTONIO CLASS
  - Fine Water Mist In Main And Auxiliary Engineering Spaces
  - HFC-227ea In Other Spaces Including:
    - Storerooms,
    - MOGAS Areas,
    - HAZMAT Storage & Issue Rooms,
    - Paint Issue Room, and
    - Ship Service Diesel Generator Enclosures

- CVN 76, USS RONALD REAGAN
  - HFC-227ea In All Spaces Including:
    - Storerooms,
    - Pump Rooms,
    - Emergency Diesel Generator Rooms,
    - HAZMAT Storage & Issue Rooms, and
    - Paint Mixing And Issue Rooms

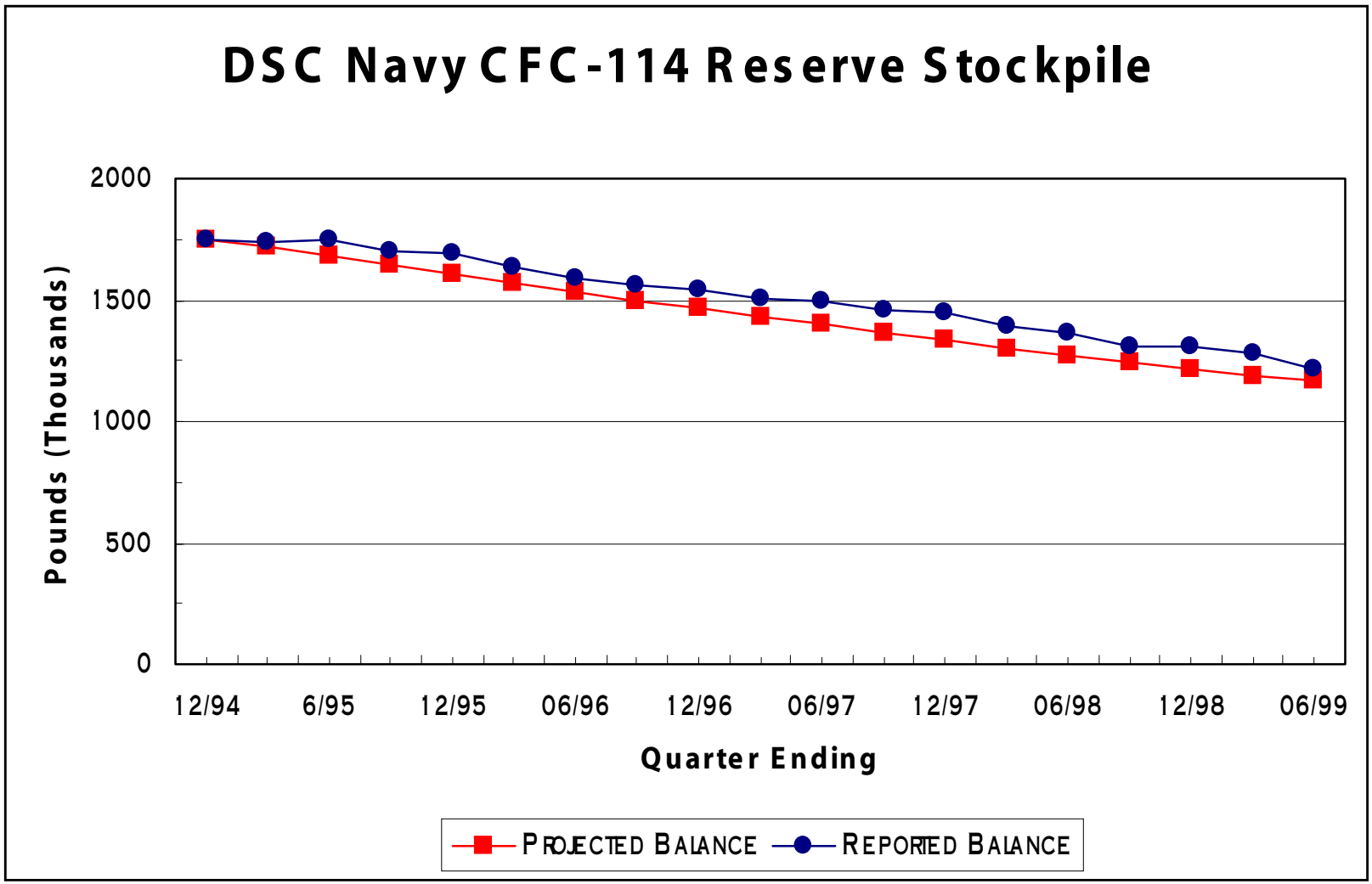
Solvent Replacement Program

- Strategy
  - Identify All Critical ODS Solvent Uses
  - RDT&E Replacement Solvents & Get Approval of Non-ODS Alternatives
  - Establish Procurement/Logistics Support of Alternative
  - Revise All Associated Documents (Specifications, Contracts, PMS, Tech Manuals)
  - Implement Alternative
- No ODS Solvent Uses Remain Except Limited O_2 System Cleaning Applications
- In Several Cases Alternatives Save Time & Money
  - Aqueous Parts Washers
  - NOC vs. CFC-113 (Annual Cost Avoidance Of $10M+)

Navy ODS Reserve

- Mission-Critical Stockpile Of CFCs And Halons Established At DSC Richmond
  - Support Mission-Critical Shipboard Applications Between The Points Of Production Cessation And The Points At Which The Last Systems Are Retired Or Converted To Ozone-Friendly Chemicals/Processes
  - Access Restricted To Authorized Users Only
- High-Level Attention
- Reserve Expected To Last Until Approximately 2050
- NAVSEA Continues To Closely Monitor The Reserve
  - Current Focus Is Determining Recovery Rates For CFC-114 Material Turn-Ins

Monitoring The Reserve



Summary

- Program Has Enabled The Navy To Transition Away From ODS Without Adverse Impact To National Security, While Minimizing Total Cost To The Navy
- Program Is Recognized As A World Leader
  - 30+ EPA Stratospheric Ozone Protection Awards
  - 1999 EPA Climate Protection Award (Energy Savings For New AC Plants)
  - Cooperative Programs With Foreign Militaries And Other Services
  - Navy Experts Are Members Of UN Montreal Protocol Technical Options Committees
- LPD 17 & CVN 76 Are The First Ozone-Friendly Ships Of The New Millennium As A Direct Result Of This Program

"The Navy program is known for its global leadership, smart technology, and sensible pace."--Ms. Drusilla Hufford, Director, USEPA Stratospheric Ozone Protection Division